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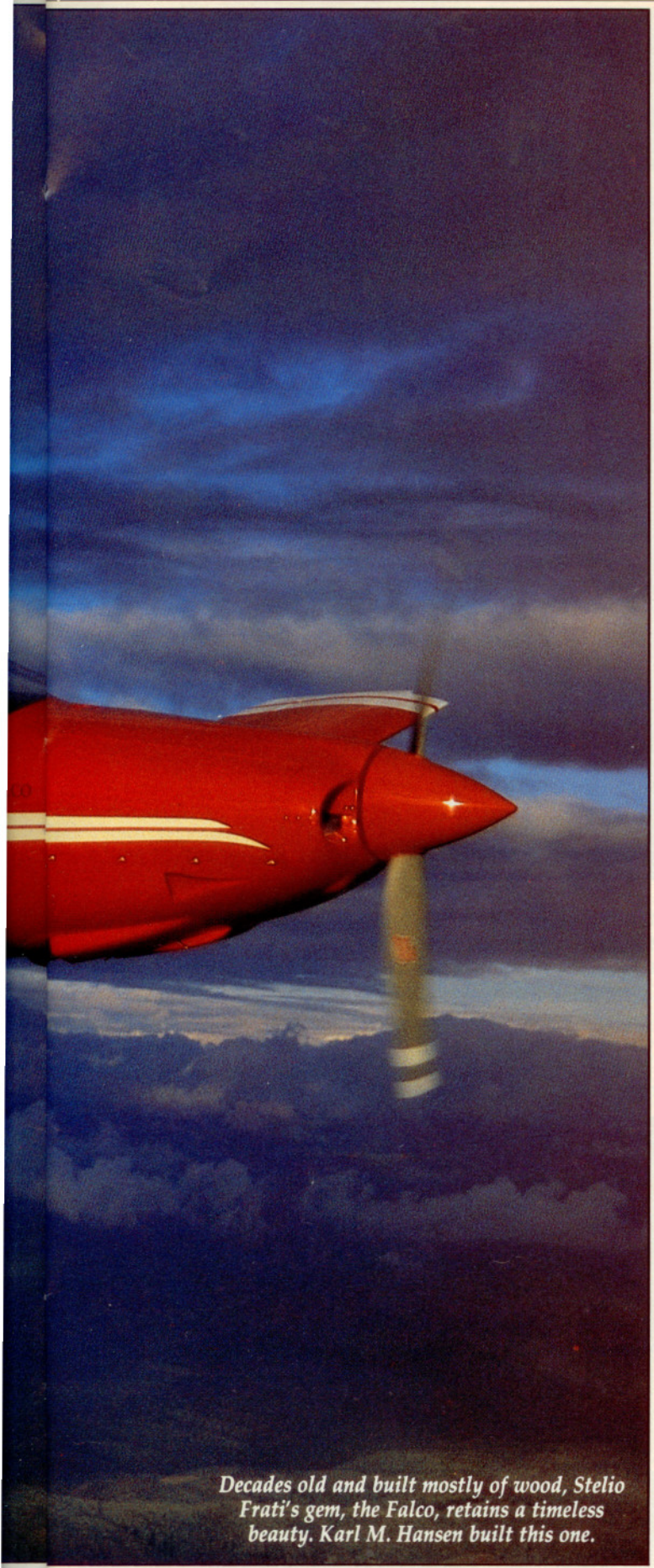

Decades old and built mostly of wood, Stelio Frati's gem, the Falco, retains a timeless beauty. Karl M. Hansen built this one.

JEFF HANSEN

KITS

THE KIT ALTERNATIVE

Your dreamplane may come in a box.

BY J. JEFFERSON MILLER

"HOME-BUILT AIRPLANES CHANGE FROM A HOBBY MARKET TO A SMALL INDUSTRY," *read the January 16, 1986,* Wall Street Journal *headline. For some of the paper's two million daily readers, the accompanying three-paragraph story was, perhaps, a mildly interesting diversion from the bigger news of corporate mergers, quarterly earnings reports and the action of the day before on the major exchanges.*

But for a handful of kit aircraft manufacturers, it was, at long last, a measure of recognition that they were not a bunch of cranks and backyard tinkerers, but rather serious designers and businessmen.

As The Wall Street Journal *noted, the growing interest in amateur-built airplanes is largely a response to the steeply rising cost and decreasing variety of new production light aircraft. Many pilots today see the purchase of a kit airplane as an alternative to buying a new or used production aircraft, despite the "sweat equity" involved in building a kit. Not everyone who desires to purchase a lightplane, however, is willing to build his own. The great hope for those who want a factory-completed,*

new-technology lightplane (or perhaps just an old-technology lightplane at an affordable price) is that some kit manufacturers already are in the process of developing new production aircraft. Others are considering doing so.

A look at the state of the amateur-built aircraft market is instructive not just for those who are considering the purchase of a kit-built aircraft, but also for those who may purchase a production lightplane in the years ahead.

●

Six months and about 600 hours of labor after it arrived in a packing crate, Charles D. (Chuck) Mason's Glasair was little more than a collection of parts scattered about his garage workshop. The fuselage, an empty white shell, occupied the center of the crowded shop floor. Unfinished wings sat to one side. A new Lycoming O-320 was still in its box, and radios and instruments were taking up shelf space along one wall. Mason was putting in three or four hours a night, almost every night, on the Glasair, and had yet to begin installing the various aircraft systems, usually the most complex part of any homebuilding effort. The project was still in its infancy, with another 2,400 hours yet to go.

Twenty months later, on a cold, clear morning in January 1985, those long, lonely hours paid off. The Glasair flew, and has since been flown by Mason for about 300 hours. Of the building experience, Mason says, "It is not for everybody. It is a long, arduous, difficult job. If you don't have perseverance and resourcefulness, you will never finish it." But he adds that flying an airplane you built yourself provides "a feeling of satisfaction that can't be achieved any other way."

For about the cost of a new Taylorcraft, Mason built himself a 200-knot, IFR-equipped, two-seat hot rod. In so doing, he joined a unique and growing fraternity of aeronautical do-it-yourselfers: the homebuilders.

To many members of the fraternity, homebuilding is not just a pastime. It is a grass-roots movement away from the expensive, old-hat products of traditional small-airplane manufacturers and toward a more innovative and diverse consumer-driven marketplace. Indeed, homebuilt designers and builders have been out in front of the established industry in exploring, among other things, the potential of composite construction materials, such as fiberglass, carbon fiber and Kevlar; new aerodynamic configurations, such as the canard aircraft of E.L. (Burt) Rutan, and new airfoils, such as NASA's natural laminar flow (NLF) series.

The efficiency of some homebuilt designs has been demonstrated in air racing events that score aircraft based on such factors as speed, payload and fuel consumption. Among the top 10 finishers in the latest CAFE 400 race, held on June 28, 1986, were eight amateur-built aircraft. (CAFE stands for competition in aircraft fuel efficiency.) The winner of the race was a Quickie Aircraft Q-200, which received the AOPA-sponsored "best overall" award. The other homebuilts were two Rutan VariEzes, Howell C. (Nick) Jones Jr.'s prototype White Lightning (winner of the AOPA-sponsored "best new design"

JOEL RIEMAN

Neico Aviation's two-seat Lancair exemplifies the highly-prefabricated, relatively-easy-to-build composite aircraft.

award), another Q-200, a Rand-Robinson KR-2, the Neico Aviation Lancair 235 prototype and George Pereira's homebuilt Pereira GP-4. One of the production aircraft was Michael D. (Mike) Smith's highly modified Beech Bonanza, which took fourth place. The other was a Mooney M20K in tenth place. Of the 51 participating aircraft, 21 were amateur-built, and the rest were production aircraft.

Since the early days of aviation, people have built their own aircraft from someone else's plans. But with the decline of the traditional general aviation manufacturers, whose sales last year hit a 40-year low, and with kits for homebuilt designs becoming more numerous, more sophisticated and more complete, a larger number of people are turning to homebuilts as an alternative to production aircraft. In the past decade, the number of FAA-registered amateur-built aircraft has more than doubled, while the general aviation fleet as a whole has grown by only a third. As of September 30, 1985, 10,778 amateur-built Experimental aircraft (out of a total 15,492 Experimental aircraft) were active.

To their purchasers, kit-built aircraft are attractive for several reasons. They offer challenging building projects to the mechanically inclined; they generally are less expensive than production aircraft; they can be maintained by their owners, and they are available in enough variety to suit a number of transportation requirements and almost every aeronautical fancy. Within the world of homebuilding, there are World War I and World War II replicas, amphibians, aerobatic biplanes, gyrocopters and helicopters, gliders, ultralights and 239-knot, two-seat executive transports.

Unlike the homebuilts of the 1950s and 1960s, which were mostly built from plans alone and required builders to scrounge for construction materials, today's kit aircraft are designed with the one-stop shopper in mind. Many include virtually all required materials and hardware. Some include engine and propeller, or make them available as options. And whereas homebuilders once had to fabricate almost every part out of raw materials, many kit aircraft components, such as landing gear assemblies, push rods, bell cranks, ribs and spars, now come prefabricated. In fact, entire airframes for composite airplanes such as the Glasair and Lancair (which is reviewed on page 66) come as a collection of prefabricated parts that the homebuilder bonds together.

Even with the extensive use of prefabricated parts, building a kit aircraft is not easy. Most homebuilders rely on technical (and to a certain extent, moral) support from fellow builders. Paralleling the growth of interest in homebuilding has been the growth of the Experimental Aircraft Association, which was formed in 1953 to foster educational efforts for homebuilders. Through a network of local chapters, EAA provides kit-building novices a source of knowledge and experience to draw upon during the construction process.

Within the kit marketplace, the pace of development is fast

Fast and eye-catching it is. But the Q-200's quirky ground handling has been a problem for some owners.

and the buyers fickle. Though some kit designs have sold well for more than a decade, a good product lifespan is considered by some designers to be about five years. A number of kit manufacturers with designs dating from the late 1970s and early 1980s are finding that they now are suffering from problems that also plague the production aircraft manufacturers: market saturation, resistance to high prices and product liability litigation.

Christen Industries President Frank Christensen comments, "Our kit sales have been soft since 1981....Anyone producing kits has to realize he is dealing in a limited market." The company's Christen Eagle II biplane, which was introduced in 1978, is considered by some homebuilders to be the most complete kit on the market, as well as the best-designed for ease of construction.

Citing declining sales, market saturation and the long term costs of product support, Rutan, who is now a vice-president of Beech Aircraft Corporation, stopped selling homebuilt aircraft plans in 1985. Also in that same year, the Quickie Aircraft Corporation filed for protection under Chapter 11 of the federal bankruptcy laws after losing a product liability lawsuit.

Ultralights, which constitute the bottom rung of the kit market and were popular only a few years ago, have all but faded away in a haze of negative publicity. (Their decline is discussed at length in the article "Ultralights: What Happened?" October 1985 *Pilot*, page 73.)

Despite signs of stagnation in some quarters, kit aircraft development appears to be quickening on two fronts. At the low-cost end of the spectrum, new designs have risen from the ashes of the ultralight market. Consider, for example, the Sorrell EXP II. The two-place, negative-stagger biplane was derived from the single-seat Sorrell Hiperlight, one of the more sophisticated ultralights. The EXP II kit sells for $11,200, including a 47-horsepower Rotax two-stroke engine and propeller, and takes an estimated 300 hours to assemble.

The brief boom in ultralight sales also spurred the refinement of the two-stroke engine. Though they have not achieved the reliability of certificated powerplants, two-stroke engines do offer the advantages of compactness and low cost.

At the high-performance end of the spectrum there is considerable competition. The Swearingen SX300, a 300-hp, two-seat, all-metal aircraft with a maximum cruise speed of 239 knots, has been the subject of much attention within general aviation circles. (The airplane is reviewed on page 62.)

Stoddard-Hamilton is in hot pursuit of the Swearingen market with a 300-hp, stretched version of the Glasair. The company plans to introduce the new model later this year. Existing Glasair kits have been improved with time-saving, prefabricated parts. (See "Glasair," March 1984 *Pilot*, page 26.)

The Prescott Aeronautical Corporation has begun shipping kits for its four-place, futuristic-looking aircraft, the Prescott Pusher. (The Pusher was the subject of a feature article in the March *Pilot*, page 98.)

The Velocity, made by Velocity Aircraft of Sebastian, Florida, is essentially a four-seat version of the Rutan-designed, two-seat LongEze. Both are made of fiberglass and have a canard and tip rudders. The prototype Velocity is powered by a 195-hp Continental IO-360 engine. The company is developing kits for the airplane.

The White Lightning, another prototype design destined for the kit market, is a conventionally configured, fiberglass airplane powered by a 210-horsepower Continental IO-360. It is one of the few homebuilts with four seats. (The rear seats face aft.) Top speed is reported to be 234 knots. The kit for the airplane will be offered by the White Lightning Aircraft Corporation of Sheldon, South Carolina. Shipments are scheduled to begin in September. (See "White Lightning," page 70).

Several Sequoia F.8L Falcos now are flying. Though the design is decades old and the structure is mostly wood, the Falco has the sculpted look and performance of comparably powered modern composite-construction aircraft. (See "Sequoia Falco," page 66.)

These are not the only high-performance designs in the air or on the drawing board. Just as Detroit has rediscovered the sports car, lightplane designers have rediscovered, and are catering to, desires for high-priced, high-performance, two- and four-place singles.

Whether the designers and vendors of these and other kit aircraft could form the backbone of a renascent light aircraft industry remains to be seen. At the moment the chances of that happening seem slim, for two reasons.

First, the certification obstacles for new designs are formida-

KITREGS

PASSENGER WARNING
THIS AIRCRAFT IS AMATEUR-BUILT AND DOES NOT COMPLY WITH THE FEDERAL SAFETY REGULATIONS FOR STANDARD AIRCRAFT

The best known of the regulations applying to homebuilt aircraft is the so-called "51-percent" rule (Federal Aviation Regulation 21.191g). This regulation states than an Experimental certificate may be issued for an amateur-built aircraft if "the major portion has been fabricated and assembled by persons who undertook the construction project solely for their own education or recreation." The FAA interprets "major portion" to mean more than 50 percent.

Noting the trend toward simpler construction methods and the extensive use of prefabricated parts, the FAA is paying closer attention to the composition of aircraft kits. A number of kits have been evaluated by the FAA for compliance with the 51-percent rule. Those that have passed muster have been placed on an FAA list of aircraft that meet the "major portion" requirement of FAR 21.191g. These aircraft are indicated by a dagger symbol next to the model name in the kit aircraft directory that begins on page 73.

If you buy a kit airplane that is not on the FAA's list (and many kits are not), then you must have the project evaluated for compliance by a field inspector from an FAA general aviation district office (GADO). The FAA advises contacting an inspector before purchasing a kit to verify that the project will meet certification requirements. Inspectors can be reached at GADOs and flight standards district offices (FSDOs). Addresses for both are listed in *AOPA's Handbook for Pilots 1986*. They can also be found in the FAA's *Airport/Facility Directory*.

Not all Experimental aircraft are classified as amateur-built. Experimental certificates also are issued for the following purposes: research and development, crew training, air racing, market surveys (mainly promotional touring with prototype aircraft) and exhibition flying for air shows or motion picture work. For aircraft so certified, the FAA often establishes a number of flight restrictions.

For an amateur-built Experimental aircraft, there is only one immutable flight restriction: The aircraft cannot be flown for compensation or hire. Suitably equipped and endorsed by an FAA field inspector, it can be flown at night and in IFR conditions.

Until very recently, the FAA required three aircraft inspections before an airworthiness certificate could be issued. Since 1985, only one inspection has been required, although additional inspections may be mandated by the inspector. According to the FAA, the self-

The fastest kit airplane and the most expensive, the Swearingen SX300 can crack the $100,000 barrier in construction costs.

ble. The current certification standards for light aircraft—Part 23 of the Federal Aviation Regulations—entail enormous expense for a small company. Estimates for certificating and developing production tooling for a relatively simple single-engine aircraft range as high as $25 million.

Certification expenses often are cited as one reason for the lack of development among the established manufacturers. However, a simplified set of certification requirements, such as the primary airplane standards proposed by AOPA and EAA, could lead to reduced certification costs and entice a number of kit manufacturers into the market for production aircraft. At last report, the proposal was languishing within the offices of Transportation Secretary Elizabeth H. Dole (see "Primary Aircraft Proposal," October 1984 *Pilot*, page 48).

At least one company already is planning the introduction of factory-built primary aircraft. Zenair, Limited, a kit aircraft

policing efforts of homebuilders were largely responsible for the relaxed inspection requirements.

The Experimental Aircraft Association's "designee" program, in particular, has made a major contribution to ensuring construction integrity. EAA designees inspect building projects and advise homebuilders throughout the construction process. Another reason for decreased inspection requirements has been the heavy workload of FAA inspectors.

The one required FAA inspection takes place before the first flight of the aircraft. The builder is expected to present a photographic and written log of the construction process, as well as all required paperwork, for certification. If everything is in order, the inspector will issue an Experimental certificate but limit flight initially to a designated test flight area. Passengers cannot be carried until the flight test phase is complete. For an aircraft that has an FAA-approved engine and propeller combination, the test phase usually is limited to 25 hours. If the engine and propeller combination is not approved, the test period must be at least 40 hours. At the end of the test phase, the pilot can endorse his own log books for flight outside the test area. The airplane then must be operated in accordance with whatever restrictions (if any) the inspector has imposed.

Since the builder of a kit airplane should be on intimate terms with every nut and bolt in his aircraft, it only makes sense that he be allowed to maintain and repair it. Twenty-six different preventive maintenance procedures specified in FAR 43.13 can be performed by pilots who do not hold airframe and powerplant certificates (see "Pilot Advisory," July 1985 *Pilot*, p. 76). Additionally, a homebuilder can be certified as a "repairman," which permits him to work on his own aircraft (although not on anyone else's). This certification enables one to perform the major maintenance normally done by certificated airframe and powerplant aircraft mechanics. FAA Advisory Circular 65-23 outlines how a homebuilder can go about obtaining repairman certification.

A few other advisory circulars are essential reading for the homebuilder:

- "Certification and Operation of Amateur-Built Aircraft" (AC 20-27C)
- "Acceptable Methods, Techniques and Practices—Aircraft Inspection and Repair" (AC 43.13-1A)
- "Acceptable Methods, Techniques and Practices—Aircraft Alterations" (AC 43.13-2A)
- "Pilot's Weight and Balance Handbook" (AC 91-23)
- "Airframe & Powerplant Mechanics Airframe Handbook" (AC 65-15A)
- "Airframe and Powerplant Mechanics Powerplant Handbook" (AC 65-12A)

All of these publications are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402; telephone: 202/783-3238. —*JJM*

ART DAVIS

The Inav Moni used to be available with only one wheel, a la sailplanes. The new tricycle gear option simplifies ground operations.

firm located in Ontario, Canada, has announced that it is expanding its facilities in preparation for production of both a low- and high-wing, two-seat, economical aircraft as soon as new U.S. and Canadian primary aircraft rules are in place. Zenair currently offers kits for a series of relatively simple two-seat, fixed-gear, aluminum airplanes. The company also offers kits for the world's smallest twin, the French-designed Cricket.

The second impediment to kit manufacturers who wish to produce completed aircraft is the high cost associated with product liability litigation and insurance. Some kit vendors and aircraft parts retailers already are affected by high product liability costs. For the few who can afford and obtain liability insurance, the price is steep, accounting for as much as one quarter of the cost of a kit. Others are risking all by going uninsured. Nevertheless, there are kit manufacturers forging ahead with plans to certificate aircraft to existing standards despite product liability costs (see "Inav, Limited," page 68).

Christen Industries, which produces factory-built Pitts Special aerobatic biplanes as well as Pitts Special and Eagle kits, now is developing a utility airplane similar to the Piper Super Cub, which no longer is in production. The new airplane is called the Husky A-1 and will be offered exclusively as a factory-built aircraft. Frank Christensen remarked that the total cost of designing and certificating the Husky will be less than the insurance premium for the first year of production.

SX300 designer Edward J. Swearingen Jr., too, has been conducting his own studies for new production aircraft. His company's recent move to larger quarters at Stinson Airport in

CAVEAT EMPTOR

The well-publicized propensity of Americans to sue manufacturers over defective products has just about rendered the maxim "caveat emptor" obsolete. "Let the seller beware" more aptly sums up today's consumer ethic.

When it comes to kit-built aircraft, though, the buyer still assumes a number of risks. You can spend more than $100,000 in the process of constructing a homebuilt, with no guarantee that the end result will be a flyable airplane. If you succeed in completing the building project, you (or another pilot) will have to test-fly the airplane. If there were errors inherent in the design or in assembly, you may find out the hard way. The degree of skill required to fly some homebuilt designs successfully is far greater than that possessed by the average pilot. It is therefore essential to evaluate the flight characteristics of a particular aircraft and acquire the training necessary to handle them.

In granting an Experimental certificate—the only type of certification available for a homebuilt aircraft—the Federal Aviation Administration does not evaluate the airplane for structural integrity or safe handling characteristics. (However, FAA inspectors do examine homebuilts for compliance with accepted construction practices.) Though some designs are well-tested, from time to time a homebuilder unwittingly plays the role of experimental test pilot, exploring the flight envelope for a kit aircraft designer.

As a prospective kit purchaser, you should ascertain the extent of previous ground and flight testing, particularly when an aircraft is new to the market, with few, if any, examples flying. Questions should include: Has the aircraft been static-load tested to determine structural load limits? Has it been tested for flutter? How many flight test hours have been accumulated, and what sorts of flight tests have been performed? Has the airplane been stalled and spun at fore and aft CG limits? Most kit aircraft designs have not been spun during flight testing, according to responses to *Pilot's* survey for the "Kit Aircraft Directory" (page 73).

The appeal of an aircraft is a highly subjective matter. Two pilots can emerge from an airplane with vastly different impressions of comfort and handling qualities, among other characterisitics. The only way to assess these factors for yourself is to fly the airplane under consideration. Arranging a demonstration flight is not as easy as it is with production aircraft. Indeed, in some cases, the only flying example is a prototype. But the alternative to flying before you buy is to accept manufacturer claims on faith.

Not all of the risks involved in purchasing a kit aircraft are related to an aircraft's structural qualities or stability in flight. A company's financial stability also should be taken into account before purchasing a kit. You want to be reasonably sure that the company will be around to supply parts and construction advice for the next few years while the aircraft is under construction. You should also consider the availability of insurance and the airplane's potential resale value.

The importance of factory support cannot be overemphasized. The best kit aircraft companies have knowledgeable employees available to answer builders' questions over the telephone. These companies also publish newsletters containing maintenance and safety-of-flight information and have a revi-

San Antonio, Texas, may presage further developments.

These projects are encouraging signs for pilots contemplating a grim future of combing through salvage yards in order to keep weary used aircraft flying. But for the time being, most designs available from kit vendors will come in a box and not as ready-to-fly aircraft.

In this special section, we focus on kit aircraft that show the variety of designs available to homebuilders. Some, such as the KR-2, have been on the market for many years and have been built and flown by hundreds of pilots. Others are so new that only prototypes are flying. Some of these aircraft are relatively inexpensive to build and operate; others could be classified as luxury singles. Most are fixed wing, but there is also one rotorcraft, the Rotorway Exec helicopter.

Some of the featured aircraft are extremely complex building projects—even those, such as the Falco, that come with excellent instructions. Others, though simple, leave plenty of opportunity for builder error. The story on Quickie Aircraft cites some examples of how small mistakes, as well as design deficiencies, can lead to handling problems.

The kit market is so broad that the eight aircraft featured herein should not be construed as a representative sample. They are simply examples of some prominent designs.

Whether or not today's kit vendors make the transition to producing completed aircraft in the years ahead, the activity in the kit aircraft market proves one thing: A market for modern general aviation aircraft exists. What follows are several indications of general aviation's vitality. □

Walter D. Nitz built this RotorWay Exec helicopter working on it part time over 18 months. Current kit price is $29,559.

sion system for plans and manuals.

Another important pre-purchase consideration is whether the aircraft meets the 51-percent amateur-built construction requirement (see "Kitregs," page 58). An aircraft that does not meet the requirement may be uncertifiable.

A self-examination of your own desires, capabilities and resources is just as important as evaluating the kit and the company that offers it and is even more important with kit aircraft than with ready-to-fly, FAA-certificated production models. This is the time to eliminate emotion from the purchasing decision. As beautiful as an aircraft may be, and as impressive as its performance statistics may seem, you still must decide with cold, calculated reason whether the claimed attributes and performance of the design meet your requirements. Also consider the lengthy project you are about to undertake. Remember that designer/vendor building time estimates can be wildly optimistic.

Do you have the skills to build a particular aircraft? Some kits require extensive wood- and metalworking, welding and electrical wiring. Many builders find that engine installation is the most difficult and critical aspect of homebuilt construction and that their kits provide scanty installation instructions. For some builders, learning new skills is part of the satisfaction of building an airplane. But those lacking basic construction skills or knowledge may find that time-consuming, expensive-to-correct and frustrating errors are part of the price one pays for a kit aircraft.

Working with composite materials often simplifies the construction process but can entail other problems. Some builders find they are allergic to certain materials, most frequently the epoxies in composite construction kits. Severe instances of dermatitis, an inflammation of the skin, have led builders to abandon their construction projects. New, low-toxicity epoxy formulations, such as Applied Plastics' Safe-T-Poxy, are less likely to produce allergic reactions. However, there are no guarantees that Safe-T-Poxy or another epoxy will not cause skin irritation.

Some kits demand more of the builder than others in terms of understanding technical drawings and blueprints. Many kits come with detailed drawings but without a builder's manual. Those that also come with thorough, step-by-step instructions can vastly simplify the construction process.

In evaluating a kit for ease of construction, you should carefully consider what has been left out, because these items may be the most difficult to obtain or fabricate. Does the kit contain engine mounts, an engine exhaust system, engine baffling, a fuel system and an electrical system? Many building projects founder when the time comes to start rigging the various systems. Building the airframe often is easy by comparison. Other final steps are equally critical. A kit should include instructions on how to check the weight and balance of the aircraft, how to conduct a safe and thorough flight test program and how to service and maintain the airplane.

Ultimately, the best sources of information on a kit are those individuals who have already built the airplane. One good test of a design is to ask the vendor for a list of current builders and owners of completed aircraft. Try to talk to a few customers before making a commitment. Local Experimental Aircraft Association chapter members can be the best source of information on specific aircraft and on particular skills and techniques.

Homebuilders are generally an enthusiastic and helpful lot. They are the experts when it comes to kit aircraft construction. —*JJM*